Short Note on Horticulture–IV

☢ Classification of Citrus

There are 7 groups of Citrus fruit-

1. The Mandarins

✓Mandarin orange: *Citrus reticulata.*

✓Mediterranean mandarin: *C. deliciosa.*

✓King mandarin: *C. nobilis.*

✓Satsuma mandarin: *C. unshiu.*

✓Spice mandarin: *C. reshni.*

✓Dancy tangerine: *C. tangerina.*

2. The Oranges

Δ Sweet orange: *Citrus sinensis.*

Δ Sour orange: *C. aurantium.*

3. The pummelos and grapefruits

⬬ Pummelo: *Citrus grandis.*

⬬ Grapefruit: *C. paradisi.*

4. The lemons

✡ Lemon: *Citrus limon.*

✡ Lime: *C. aurantifolia.*

✡ Citron: *C. medica.*

✡ Rough lemon: *C. jambhiri.*

✡ Sweet lime: *C. limettioides.*

✡ Rangpur lime: *C. limonia.*

5. The inter-specific and Inter-generic hybrids

A. Inter-specific hybrids

■ Tangors: Mandarin X Sweet orange.

■ Tangelos: Mandarin X Grapefruit.

■ Lemonimes: Lemon X Lime.

B. Inter-generic hybrids

✡ **<u>Ponicirus</u> X <u>Citrus</u>**

• Trifoliate orange X Sweet orange (Citranges).

• Trifoliate orange X Grapefruit (Citrumelo(s))

• Trifoliate orange X Sour orange (Citradias).

6. The wild and Semi-wild species

✓Indian wild orange: *Citrus indica.*

✓Adajamir: *Citrus assamensis.*

7. The related genera

A. Only one genera: *Poncirus*.

✓Trifoliate orange: *Poncirus trifoliata.*

B. Fortunella (two species)

✓Round kumquat: *Fortunella japonica.*

✓Oval kumquat: *F. margarita.*

☢ Propagating materials of Pineapple

The propagation of pineapple plants is mostly carried out by means of crowns. Seeds are not preferred owing to their slow growth. Other parts of the plant such as 'slips' and 'suckers' are also used for propagation. While preparing the crown for propagation, its lower leaves are peeled off to expose the 'root primordia'. Crowns are then planted in a potting soil known as 'Bromeliad Potting Soil'. Then the plants are grown in pots for few days before moving them in fields.

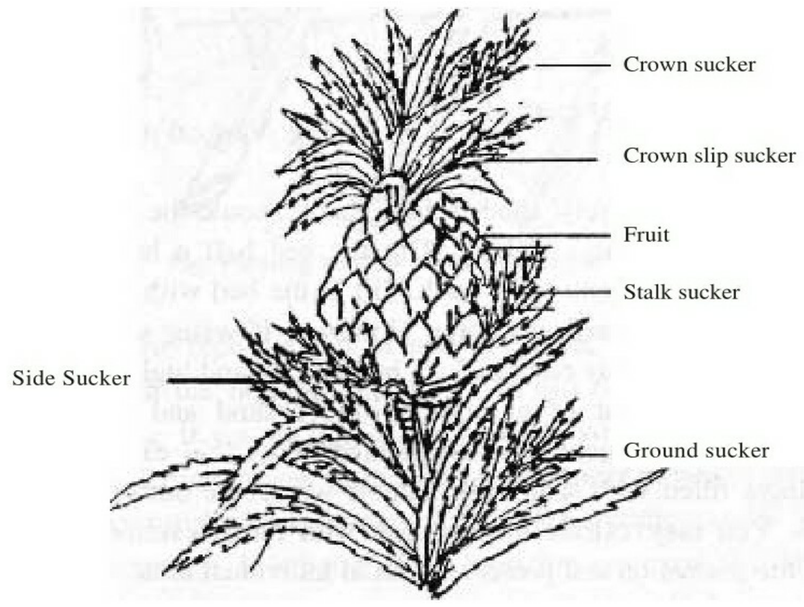

Fig : Different kinds of sucker of pineapple

Sucker Propagation: Planting suckers allow fast growth of pineapples in comparison to the traditional method of planting the crown. Suckers are found between leaves of fully-grown pineapple plants. They can be pulled out with the hand and just have to twist them at their base. It also prevents the plant (sucker) from getting hurt. Rest of the procedure for growing pineapple plants is same as that used in the traditional method.

Slip Propagation: Slips can be found at the base of pineapple fruits. These are tiny plants not found in all varieties of pineapples. Pull and plant the slips just like suckers. The method used for growing pineapples from slips is same as the traditional one.

Crown Propagation: It is the most common method of propagation in pineapples. The crown is pulled or cut off from the fruit and kept for rooting for about 3 weeks after which short roots emerge. The crown can then be used for potting in the house or field cultivation.

Pineapple plants also produced through tissue culture are also available for cultivation.

☢ Planting materials of Banana

Planting material used for propagation namely–

►Suckers. ►Peepers. ►Rhizome.

►**Suckers:** A sucker is a lateral shoot that develops from the rhizome and emerges from the soil usually near the parent plant. It two types–

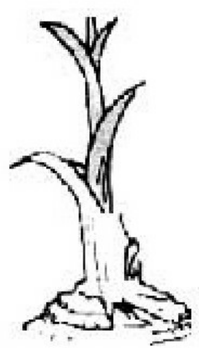

Fig: Sword sucker

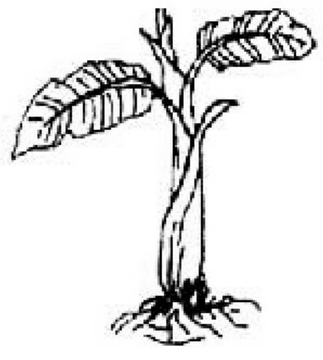

Fig: Water sucker

a) Sword Sucker: A suckers which continue to grow and produce leaves with a midrib and a very narrow lamina. They are then called sword sucker. It is vigorous sucker which used for replanting.

b) Water sucker: A sucker which attach to the mother rhizome with broad leaves at an early stage. Water suckers produce inferior fruit (not healthy banana clump) and are therefore not recommended for planting.

►**Peepers:** Peepers (very young suckers) produce late and poor crop. Four month old suckers and split rhizomes (each having about 2.0 Kg) produced heavier bunches compared with those obtained from peepers.

►**Rhizomes:** Whole or split rhizomes can also be used when suckers are not available. Bits of rhizome of 2.0 Kg or more may be planted in the nursery for sprouting or directly sown in the main field. For quick multiplication of a variety rhizome bits may be used. Though the plants will require little longer time to fruit.

☢ Minor and Exotic Fruit

►**Minor Fruit**

In United States agriculture policy, Minor fruit refers to fruit that may be high in value but that are not widely grown. Many crops, vegetables and tree nuts come under this definition. e.g. Mangosteen, Carambola, Bilimbi, Phalsa, Mulberry, Avocado, Fig, Tamarind, Bread fruit etc.

Criteria

1. Relatively less palatable than other fruits.

2. Have lesser demand in the market.

3. Grown to a limited extent only.

4. Usually not cropped in organized plantations with application of inputs.

Other terms that are used for these fruits are less-known fruits, less appealing fruits, less-exploited fruits, stray fruits, wild fruits etc.

►**Exotic fruit**

Any edible fruit regarded as exotic especially in origin, taste or appearance. Exotic fruits are that which are not native and that are cultivated outside, available at their place of origin.

Criteria

1. Not native fruit.

2. Mainly Cultivated outside of the native region.

3. Available in its origin place.

In Bangladesh Apple, Dragon fruit, Rambutan, Mandarin, Grape, Pear etc are Exotic fruit.

☢ Unfruitfulness associated with External and Internal Factors

➡ **Some Definitions:** In an orchard all the fruit trees do not bear equally or regularly. Some times one fails to bear at the same time another tree under similar conditions produces a heavy crop. This problem may be due to failure to set fruit, unfruitfulness and activity.

The following terminology is useful in understanding the problem of unfruitfulness.

1. Fruit Set: The changes which mark the transition (stage) of flower into young fruit is called as Fruit set.

Or, The development of ovary and adjacent tissues following the blossomiting is called as Fruit set.

2. Fruitfulness: The condition in which plant not only blossom and set the fruits but carries it upto maturity then the condition is called as fruit fullness. Fertile fruits plants are necessarily be fruitful and all the fruitful plants need not be fertile.

3. Unfruitfulness: When the tree produces abundant flowers, set the fruits, but unable to carry them upto maturity is known as unfruitfulness.

Or, When plant produces abundant flowers, set the fruits but there is no fruiting, at all then such conditions is called as unfruitfulness.

4. Fertility: It refers to the ability of the plant not only to set and mature fruits but to develop viable seeds.

5. Infertility Or Sterility: It refers to the ability of the plant to set and mature fruit without viable seed.

6. Self Fruitfulness: It indicates the ability of plant to mature fruit without aid of pollens from some other flower, plant or variety and those plants are self fruitful plants.

Factors

➡ **Genetic Factors for Unfruitfulness**

1) Sterility: A land is said to be self sterile if it does not fruit with its pollen. Often many varieties of fruits are partially self sterile giving a poor fruit set with their own pollen.

Some varieties do not set fruit only with their own pollens but also with the pollens of several other varieties. They are said to be besides being self sterile, cross sterile in respect of those varieties. They will set the fruits with the pollens of certain other varieties which supply them compatible pollens. Such varieties can fruit only when compatible pollens are available in the vicinity.

2) Hybrid Condition: Hybrid between distantly related from are sometimes to produced self sterility.

3) Incompatibility: In several deciduous fruits, the pollen of some varieties are in capable of fertilizing the flowers of certain other varieties or of the same variety.

4) Slow Growth of Pollen Tube: Poor growth rate of pollen tube in the style, possible due to hormonal control. The growth rate of pollen tube may be slow due to several causes including low temperature.

5) Nutritive Condition within the Plant: Nutritive conditions of a plant just before or at or just after the time of blossoming is important in determining the percentage of flowers carrying for setting and for maturity. Its effect may be on pollen viability or on fertility of pistils. So far the internal conditions of plant are concerned deficiencies of carbohydrate results in failure of crop.

On the basis of nutritional status, fruit trees have been divided into 4 general groups.

i) C/NNNN: Plants in this group make poor growth and bear little crop or no fruit shaded or over crowded trees falls in this category.

ii) CC/NNN: Excess of nitrogen is present with sufficient amount of carbohydrates for strong and succulent growth.

iii) CCC/NN: Excess of carbohydrates leads the plants to its favorable growth and fruit set. Under such condition optimum fruitfulness can be obtained.

iv) CCCC/N: Excess amount of carbohydrates and small quantity of nitrogen leads to the poor growth of and small amount of fruits, Neglected trees fall under such category.

➡ External Factors for Unfruitfulness

1. Nutrient Supply: Application of manures and fertilizers to the tree bearing emergence of flower is generally believed to favour fruit set. Although heavy nitrogenous manuring will stimulate vegetative growth, over bearing previous season exhaust the tree and reduce subsequent flowering. Loss of nutrition in a weak shoots causes fall of slower before and after fruit set.

2. Climate: Light, temperature, rainfall, humidity and wind are the major factors which favour fruit set or other wise results in unfruitfulness.

►High temperature at flowering will dry up the stigmatic fluid and prevent pollination.

►Reduced illumination due to close spacing, over crowing of branches or shade will often reduce flowering.

►Heavy rains at blossoming may result into poor fruit set due to washing away of pollens and there by restricting pollinator activity. Flowers of mango are especially sensitive to fog rain and cloudy weather. Cloudy weather and rain are responsible for destroying blossom and newly set fruits of grape vine.

►High wind velocity may results into shedding of flowers and fruits.

3. Pest and Diseases: Attack of pest and diseases adversely affect fruit set. Mango hopper and citrus psyalla suck the cell sap from mango and Santra flowers respectively causing them to shed.

4. Locality: A variety suitable for one locality may not suit for another locality and thus may lead to unfruitfulness.

5. Disturbed water Relations: Moisture deficit created at a critical stage of flowering and fruit set will result into low fruit set.

6. Cultural Practices: Deep ploughing at flowering stage, excessive irrigation growing of weeds etc. may result in shedding of fruits.

7. Pruning: Pruning induces the fruit set in grape, fig and rose.

➡ Remedies to Control Unfruitfulness

1) Evolutionary Factors: Unfruitfulness due to evolutionary factors is mainly associated with pollination, following fertilization and by ensuring the cross pollination in such plants fruit set can be achieved or unfruitfulness can be avoided to some extent and thus of pollens can be effected in several ways–

i) Hangmg or tymg wire netted basket containing pollenizer's flower at different places in the orchard. Pollination of smayrna fig with soporifics is effected in this manner.

ii) Shoots of pollenizer's plants can be top worked on the orchard trees. These can serve permanently as polientison.

iii) Pollenizers trees may be interplanted in the orchard/in suitable numbers in different pockets. 10% of male plants of papaya is required for Hood fruit set.

iv) Rearing of honeybees colony will be effective for transfer of pollens.

Genetic Factors: Some varieties are sterile, self unfruitful cross sterile, in such cases block of other varieties which provide compatible pollens should be established.

Physiological Factors:

i) By application of plant growth regulator, growth rate of pollen tube in toe style can be enhanced.

ii) By maintaining the proper nutritive health of the plant and attending CCC/NN ratio, will produce optimum fruitfulness.

iii) Special horticultural practices like bahar treatments ringing may improve fruit set by bringing the plant in CCC / NN ratio.

External Factors:

i) Timely application of manures and fertilizers with adequate quantities will improve the health of the plant and ultimately retention of fruits.

ii) The varieties which are suitable to particular climate may be grown.

iii) Wind breaks should be planted on south–west side of orchard to protect the plant from high wind velocity with high temperature and low humidity. This will avoid-the drying of stigmatic fluid and shedding of flowers and fruits.

iv) Cloudy weather, low temperature, high humidity are the conditions favorable for breeding of certain pest and spread of certain diseases. Timely control of pest and diseases during this period may protect plant from low fruit set or failure of crop.

v) Excessive moisture supply, deficient moisture supply or fluctuating moisture at the critical stage of flowering and fruit set may try toe crop into failure one hence adequate and timely irrigation frequencies be maintain to regulate moisture supply.

vi) Deep ploughing at flowering be avoided for obtaining good fruit set. Priming is necessary in Grape, phalsa for obtaining good fruit set.

☢ Climatic Requirement for Mango

- Mango is a tropical fruit but is successful in sub-tropical conditions.
- At the time of flowering the occurrence of frost and rain is harmful.
- They prefer low rainfall, low relative humidity at flowering, fruit set and harvest.
- Warm to hot temperatures is suitable for fruiting.
- The most suitable temperature for the growth of mango is 22 – 27°C.
- Rains at fruit maturity are beneficial for the improvement of fruit size and quality.

☢ Banana

Climatic Requirement

►Banana, basically a tropical crop, grows well in a temperature range of 15ºC – 35ºC with relative humidity of 75-85%.

►Chilling injury occurs at temperature below 12ºC.

►High velocity of wind which exceeds 80 km /hr. damages the crop.

►Four months of monsoon (June to September) with an average 650-750 mm. rainfall are most important for vigorous vegetative growth of banana.

Soil

✓Deep, rich loamy soil with pH between 6.5 – 7.5 is most preferred for banana cultivation.

✓Soil for banana should have good drainage, adequate fertility and moisture.

✓Saline soils, calcareous soils are not suitable for banana cultivation.

✓A soil which is neither too acidic nor too alkaline, rich in organic material with high nitrogen content, adequate phosphorus level and plenty of potash is good for banana.

☢ Citrus

Climate

►For better growth and fruiting, citrus plants required 14-40°C temperature.

►Optimum temperature is 25-30°C.

►Temperature best for fruit development, quality and skin colour is 29°C.

►Growth stunted If temperature goes below 13°C or raise above 38°C.

►Low humidity favours skin colour and external quality of fruits.

►Optimum rainfall for Citrus ranges between 125-185 cm.

►But uniformly distributed 70 cm rainfall seen to the best for citrus.

Soil

✓Well drained Highland with sandy loam soil is good for citrus.

✓Suitable soil pH Ranges between 5.5-7.5.

✓Wet land is not good for citrus cultivation.

☢ Honey Dropping of Mango

Causes

It is not a disease but it is the expression of situation only. Honey dropping is seen in the mango tree due to adverse weather condition during flower production. Flower are spoilt and dropped due to the influence of heavy fog. Precipitation and cloudy weather, during this period the Pollen grain of mango is washed away due to rainfall resulting in hampering of pollination. As a result fruiting does not occur successfully.

Normally the incidence of mango Hopper, increases during cloudy day. Basically Honey dropping occurs due to the attack of this Hopper.

A kind of a sticky sweet substance or Honey is exudated from the body of Larvae of this Hopper. It is actually called Honey dropping when one goes under the focus Honey drop on his body. This Honey is pursued with leaves and flowers which forms an Adhesive structure. Subsequent a black like fungus, increases of this sticky substances and finally rotten structure and makes black.

If there prevails fog the dispersion of its occur more even the whole inflorescence maybe seriously hampered.

In addition anthracnose and powdery mildew attack more during the cloudy day. For this case most of the inflorescence of mango trees are damaged and dropped down. As a result fruiting does not occur.

Control of honey dropping

There is no way to control this phenomenon because there is no hand on nature. But suitable insecticide or pesticides may be applied for prevention this situation to some extent-

1. We can use Ripcord 10 CC or Rafgor 40 EC or Sevin 0.1% to control insect.

2. We can also use Bordeaux mixture or 0.2% Dithane M-45, 0.2% Thiovit at 10-20 days interval through spraying.

☢ Problem and solution of mango cultivation

⚒ Fruit dropping

►Fruit drop time (stage)

✡ February–March (When Flowers and pea size of fruit).

✡ May–June (When Developed fruits).

►Causes

Naturally many causes of fruit dropped. The causes of fruit dropping divided into two groups-

A. Internal causes

1. Genetical structure.
2. Self incompatibility.
3. Lower receipt of pollen grain by stigma.
4. Weakness of pollen grains.
5. Formation of absicic layer at the base of the flower.
6. Defective complete flower.

B. External causes

1. More fruiting in an inflorescence.
2. Deficiency of Nitrogen substances.
3. Lack of Balanced fertilizer.
4. Long time prevailing drought condition.
5. Sudden wind.
6. Strong wind.
7. Hailstorm.
8. Infestation of insect and disease pest.

9. Lack of soil moisture.

10. Lack of vigour.

C. Other Factors

The shed is more of seedless fruits than of seeded ones. It is also said that cross pollinated fruits keep better on the tree than self pollinated fruits.

Younger plant shed more fruits than older ones probably owing to lack of nutritional reserves.

►Remedies of fruit dropping

1. Application of Balanced fertilizer.

2. Balanced irrigation.

3. Control of insect pest and disease.

4. Selection of varieties which reduced fruit dropping.

5. Apiculture is to be followed for the assistance of pollination.

6. Planting of long plants around the Mango Garden for windbreak.

7. Optimum pruning should be done.

8. Application of growth regulators.

9. Intercultural operation should be done properly.

10. Careful cultivation practices.

11. Provision for pollenizers.

►Causes of lower fruit setting/production of mango.

1. Lower amount of bisexual flower.

2. Fruit dropping.

3. Prevailing adverse weather condition during blooming.

4. Failurity of pollination.

5. Failurity of the receipt of pollen grain by stigma.

☢ Alternate bearing of fruit

►Alternate fruit bearing

Alternate bearing refers to the tendency of an entire tree to produce greater than average crop one year and a lower than average crop the following year.

►Factors responsible for alternate bearing

1. Varietal characteristics.
2. Adverse environment.
3. Size and age of Shoots.
4. C and N ratio.
5. Hormonal imbalance.
6. Lack of proper management.
7. Excess fruit bearing.
8. Infestation of insect and pest.

►Control/Remission of alternate bearing

1. Avoid cultivation of alternate bearing variety.
2. Planting of regular fruit bearing varieties.
3. Proper management of orchard.
4. Pruning and training.
5. Smudging to trees.
6. Application of hormone.
7. Ringing.
8. Fruit and leaf thinning.

☢ Plant Propagation by Specialized Structures

1. Suckers: A sucker is a shoot which arises on a plant from below the ground. The most precise use of this term is to designate a shoot which arises from an adventitious bud on root. However, in practices, shoots, which arise from the vicinity of the crown are also referred to as suckers even though originating from the stem tissues. The tendency to suckers is a characteristic possessed by some plants and not other. E.g Banana, red raspberry, black berry and chrysanthemum.

2. Crowns: The term crown is used to designate the part of a plant stem at and below the surface of the ground from which new shoots are produced. Division of the crown is an important method of propagation and this division will plants. E.g. African violet, strawberry.

3. Bulb: Bulbs are produced by monocotyledons plants in which the usual structure is modified for storage and reproduction. A bulb is a specialized underground organ consisting a short, fleshy, unusually vertical stem axis, at apex a growing point and enclosed by thick flexi scales. Bulb scales morphologically are the continuous sheathing leaf bases. The outer scales, Bulb scales morphologically are the continuous sheathing leaf bases. The outer scales are generally fleshy and

contain reserve food material. Grown develop in the exile of these sales, to produce miniature bulbs known as bulbets. Arial bulblets are called bulbils. Bulbets or bulbils will be separated and used for propagation. E.g. onion, bulbous iris.

4. Corms: A corm is the swollen base of a stem axis enclosed by the dry, scale like leables (in contrast to the bulb) which is predominantly leaf scalds a corm is a solid stem structure with district nodes and internodes. The bulk of the corm consist of storage tissue composed of parenchyma cells. In the mature corm, the dry leaf bases persist at each of these nodes and enclose the corm. This covering is known as the tunic and gives a protection against injury and water loss. Propagation is dry forms which will develop on the corm. E.g. Gladiolus.

5. Tubers (Stem Tubers): A stem tuber is the short terminal portion of an underground stem which has become thickened because of the accumulation of reserve food materials. E.g. potato, propagation by tuber can be carried out either by planting the whole tubers or by cutting them into sections, each containing a bud or eye.

6. Tuberous Roots (Root tubers): Certain herbaceous perennial produce thickened roots which contain large amount of stored food. The tuberous roots differ from the tubers in that they lack nodes and internodes. Adventitious buds are present only at stem and these fleshy roots are separated and used propagation. E.g. Sweet potato, Dahlia.

7. Rhizomes: A rhizome is a horizontal stem growing either underground or along the surface of the ground. Typically it is the main axis of the plant, producing roots on it lower surface and extends leaves and flowering shoots above the ground. It may be thick and fleshy or slender and elongated but it is always made up of nodes and inters nodes. E.g. Canna, Ginner, propagation by Rhizomes consist of cutting or dividing the rhizome into selection each of which is capable of producing new shoot (it should have nodes) from nodes and foods from adventitious buds of lower surface.

8. Runners: A runner is specialized stem which develops from the axial of a leaf at the crown of a plant. Grows horizontally along the ground and forms a new plant at one of the nodes. E.g. strawberry, In propagating by runners the rooted daughter plant are dug when they have become well rooted and transplanted to the desired locations.

9. Stolen: Stolen is a term used to describe various types of horizontally growing stems that produce adventitious roots when comes in contact with the soil. Specifically these are prostrate stems as found in Bermuda grass (*Cynocen eactyon*), the underground stem of the potato that terminal as in tuber is a stolen.

☢ Stock Scion Relationship

A grafted or budded plant can produce usual growth patterns which may be different from what would have occupied if each component part of graft age viz. root stock and scion were grown separately or when it is grafted or budded in other types of rootstocks. Some of these have major horticultural value. This varying aspect of rootstocks in the performance of a scion cultivator or vice versa is known as "Stock Scion relationship".

A) Effect of Stocks on Scion Cultivars

B) Effect of Scion on Rootstock

Effect of Stocks on Scion Cultivars

1. Size and Growth Habit: In apple, rootstocks can be classified as dwarf, semi dwarf, vigorous and very vigorous based on their effect on a scion cultivator. If a scion is grafted on dwarf rootstocks the graft combination will be dwarf while the same cultivar grafted on very rootstock would grow very vigorously. In citrus, trifoliate orange is considered to the most dwarfing rootstock for grape fruit and sweet oranges. On the other hand, in mango all plants of a given variety are know to have the same characteristic canopy shape of the variety despite the rootstocks being of seedling origin. But recently, rootstocks of kalarady, Olour have been found to impart dwarf ness in the scion cultivators. Guava cultivars grafted on *Psidium puminum* are found to be dwarf in stature.

2. Precocity in Flowering and Fruiting: The time taken from plating to fruiting (Precocity) is influenced by rootstocks. Generally fruiting precocity is associated with dwarfing rootstocks and slowness to start fruiting with vigorous rootstocks. Mandarin, when grafted on Jamberi rootstocks are precious than those grafted on sweet orange or sour orange or acid lime rootstocks.

3. Fruit Set and Yield: The rootstocks directly influence on the production of flowers and setting fruits in oriental persimmon (*Diospyrous kakij* cv. Hichiya). When it is grafted used as the rootstock, the fruit set is more. The influence of rootstock on the yield performance or cultivar has been well documented in many fruit crops. Acid limes budded on rough lemon register nearly 70 percent increased yield than those budded on troyer citrange, Rangpur lime or its own rootstock. Sweet orange var. Sathgudi budded on Kichili rootstock gave higher yield than on Jamberi or on its own seeding (South India).

4. Fruit Size and Quality: Sathgudi sweet oranges grafted on Gjanimma rootstocks produced large but poor quality fruit, while on its own roots they produced fruits with high juice content and quality. The physiological disorder 'granulation' in sweet orange is very low of grafted on Cleopatra mandarin seedlings, on the other hand Rough lemon seedlings, stocks induced maximum granulation. The physiological disorder 'black end' in Barlett Pear did not appear if *Pyrus commnis* was aged as the rootstock, when *P. pyrisfolia* was used as the rootstock. This disorder appeared, affecting fruits quality.

5. Nutrient Status of Scion: Rootstocks do influence the nutrient status of scion also. Sathgudi sweet orange trees have a better nutrient status of all nutrients in the leaves when on its budded on *C. volkarminriana* rootstock than on its own rootstock or Cleopatra mandarin stocks.

6. Winter Hardlines: Young grape fruit trees on Rangpur lime withstand winter injury better than on Rough lemon or sour on orange. Sweet orange and Mandarins on trifoliate were more cold hardy.

7. Disease Resistance: In citrus considerable variability exists among the rootstocks in their response to diseases and nematodes. For instance Rough lemon rootstock is tolerant to tristesa, xyloprosis and exocorita but is susceptible to gummosis and nematode. On the other Troyer citrange is tolerant to

gummosis but susceptible to exocorita virus disease. Similarly guava varieties grafted on Chinse Guava, (*Psidium friendichthalliahum*) resist wilt diseases and nematodes.

8. Ability to Resist Soil Adverse Conditions: Among the citrus rootstocks Trifoliate orange exhibits poor ability, while sweet oranges, sour orange, Rangpur lime rootstocks exhibit moderate ability to resist excess salts in the soil. In some fruits, similarly, variation exists among rootstocks to resist excess soil moisture or excess boron in the soil. Myroblam plim rootstocks generally tolerate excess boron and moisture that Marianna pljum root or other rootstocks viz. peach, apricot or almond.

Effect of Scion on Rootstock

1. In apple it has been found that if apple seedling were budded with the "Red Astrochan" apple the rootstock produced a very fibrous root system with few top roots. On the other hand, if scion cultivar is less vigorous than the rootstock cultivar the rate of growth and the dry ultimate size of the tree is more determinate by the scion rather than the rootstock.

2. Cold Hardiness of the Rootstock: Cold hardiness of citrus roots is affected by the scion cultivar. Sour orange seedlings budded to 'Eureka' lemon suffered much more from winter injury than the unbudded seedlings.

3. Age of Root Stock Seedling: Young mango rootstock seedlings (6 months to one year old) were found to put forth inflorescence when the branches from old trees are inarched which will be attributed to the influence of scion on the rootstock.

1. Incompatibility: Certain rootstock and scions are incompatible; therefore, the graft union between these two will not normally take place.

2. Kind of Plant: Some species like oaks are difficult to graft but apple and pears are very easy in predicting a successful graft union.

3. Environmental Factors During and Following Grafting: There are certain environmental requirements which must be met for callus disses to develop and heal the graft union.

a) Temperature has a pronounced effect on the production of callus tissues. An optimum temperature as essential for the production of callus tissues. In most of the temperate fruit crops callus production is retarded after 100°F.

b) Relative humidity must be high or maintaining a film of water against the callusing surface is essential to prevent these delicate thin walled parenchymatous cells from drying.

c) Presence of high Oxygen intent near this surface is essential.

4. Growth Activity of Stock Plants: Some propagation methods, such as 'T' budding and bark grafting depend upon the bark 'slipping' which means the cambial cells actively dividing and producing young thin walled cells on the side of the cambium. These newly formed cells separate readily from one another as the book slips.

5. Propagation Techniques: Sometimes the techniques used in grafting are so poor that only a small portion of the causal regions of the stock and scion are brought together. This measurement in is failure of the graft union.

☢ Micro Propagation

Micro propagation (tissue culture or in-vitro culture) refers to the multiplication of plants, in aseptic condition and in artificial growth medium, from very small plant parts like Meristem tip, callus embryos, anther etc. The German plant physiologist heberlandt 1902 first described the biological principles of tissue and organ culture. After that rapid advantages have been made in plant tissue culture. At present tissue culture finds extensive application in agriculture and horticulture in several countries. Though some achievements have been made but the commercial utilization of the techniques of tissue culture is still lacking behind.

Methods of Micro-propagation

1. Meristem Culture: In Meristem culture, the Meristem and a few subtending leaf primordial are placed into a suitable growing media. Art elongated rooted platelet is produced after some weeks is transferred to soil when it has attained a considerable height. A disease free plant can be produced by this method. Experimental results also suggest that this technique can be successfully utilized for rapid multiplication of various herbaceous plants.

2. Callus Culture: A callus is mass of undifferentiated parenchymatous cells. When a living plant tissue is placed in an artificial growing medium with other conditions favorable, callus is formed. The growth of callus varies with the homogenous levels of auxin and Cyotkininn and can be manipulated by endogenous supply of these growth regulators in the culture medium. The callus growth and its organogenesis or embryogenesis can be referred into three different stages.

✓Stages – I: Rapid production of callus after placing the explants in culture medium.

✓Stage – II: The callus is transferred to other medium containing growth regulators for the induction of adventitious organs.

✓Stage – III: The new plantlet is then exposed gradually to the environmental condition.

3. Cell sustention culture: A cell sustention culture refers to cells and or groups of cells dispersed and growing in an aerated liquid culture medium (Street, 1997, Thorpe1981) is placed in a liquid medium and shaken vigorously and balanced dose of hormones. Suezawa et al (1988) reported Cyotkininn induced adventitious buds in kiwi fruit in a suspension culture sub-culture for about a week.

4. Embryo Culture: In embryo culture, the embryo is excised and placed into a culture medium with proper nutrient in aseptic condition. To obtain a quick and optimum growth, it is transferred to soil. It is particularly important for the production of interspecific and intergeneric hybrids and to overcome the embryo abortion.

5. Protoplast Culture: In embryo culture, the plant cell can be isolated with the help of wall degrading enzymes and growth in a suitable culture medium in a controlled condition for regeneration

of plantlets. Under suitable condition, the protoplast develop a cell wall followed by an increase in cell division and differention and grow into a new plant. The protoplast are fist culture in liquid medium at 25 to 28°C with a light intensity of 100 to 500 lux or in dark and after undergoing substantial cell division, they are transferred into solid medium congenial or morphogenesis. In many horticultural crops response well to protoplast culture.

Merits of Micro Propagation

1. Tissue culture helps in rapid multiplication of true plants throughout the year.

2. A new plant can be regenerated from a miniature plant part, whereas in conventional methods a shoot of considerable length is required.

3. Large number of plants can be produced in culture tubes in small space with uniform growth and productivity of growing them in large area in nursery.

4. Plants raised by tissue culture are free from diseases.

5. Tissue culture coupled with somatic hybridization helps in evolving new cultivar in a short time.

6. Micro propagation facilitates long distance transport of propagation material and long term storage of clonal materials.

7. Tissue culture methods are not viable (male sterile) or not available easily (e.g. banana) and in plant where propagation by conventional methods are expensive (e.g. orchid).

Demerits of Micro Propagation

1. The cost involved in setting up and maintenance of laboratory is very high and may not justify their use in all the horticultural plants ordinarily.

2. Tissue culture techniques require skill and manpower.

3. Slight infection may damage the entire lot of plants.

4. Some genetic modification (mutation) of the plant may develop with some varieties and culture systems which may alter the quality of the produce.

5. The seedling grown under artificial condition may not survive when placed under environmental condition directly if thing is not given.

☢ Apomixis

The process of development of an embryo in seed without pollination and fertilization is known as apomixis and the seedlings produced in this manner are known as apomicts.

Apomictic seedlings are identical with its mother plant; it has the same genetical makeup as that of the mother plant. The apomictic seedling are completely free from virus. Plant that produce only apomictic embryos are known as obligate apomicts and those that produce both apomict and sexual seedlings are called facultative apomicts.

Types of apomixis

1. Recurrent apomixis: In these type of apomixis, embryo develops from the diplod egg cell or from diplod cells of the embryo sac without fertilization. e.g. *Allium*.

2. Non recurrent apomixis: In these type of apomixis, embryo develops from the haploid egg cell or from the haploid cells of the embryo sac. In this case plants are produced which contain only one set of chromosomes. Hence, the plants are sterile in nature and cannot perpetuate. e.g. *Solanum nigrum*, *Lilium* spp. etc.

3. Nucellar embryony: In these type of apomixis, embryo develops from the diploid cells outside from the embryo sac. i.e. cells of nucellus, integuments. e.g. Citrus, mango etc.

4.Vegetative or bulbils: In this type of apomixis, the flowers in an inflorescence are replaced by Bulbils or vegetative bud which sprouts, while still on the mother plant into new daughter plants. e.g. *Allium*, *Agave* etc.

Advantage

►Seedling is identical.

►The same genetical make up occurs.

►It is free from virus.

Scientific name, Propagation and available in market time of different Fruit

Fruit name	Scientific name	Propagating materials	Available in market
Hog plum (আমড়া)	*Spondias mombin*	►Seed or Asexual propagation (cleft grafting).	April—October.
Custard apple (শরিফা)	*Annona squamosa*	►Grafts and budded plants.	August—December.
carambola (কামরাঙ্গা)	*Averrhoa carambola*	►The carambola is widely grown from seed. ►Air-layering, shield-budding, bark-grafting, cleft-grafting also done.	April—October.
Elephant apple (চালতা)	*Dillenia indica*	►Chalta can be easily propagated from fresh seeds. ►Cutting can be used for vegetative propagation.	October—December.
Wood apple (কদবেল)	*Feronia limonia*	►The wood apple is generally propagated through seeds . ►Multiplication may also be done by root cuttings, air-layers or by budding, cleft grafting.	October through March

Olive (জলপাই)	*Olea europaea*	►Propagation can be done either through seeds or cuttings (tongue grafting, Patch-budding & i-budding are most effective methods).	November—February.
Tamarind (তেঁতুল)	*Tamarindus indica*	►Tamarind is propagated through seeds. ►Grafts (Softwood grafting), shield-budding, and Air Layering.	January—April
Rose apple (জামরুল)	*Syzygium samarangense*	►Propagation of rose apple trees can be done by seed or saplings. ►Major propagation is carried out by cuttings and air layering.	April – October.
Plam (তাল)	*Borassus flabellifer*	►By seed	April—October.
Pomegranate (ডালিম)	*Punica granatum*	►Propagation by cuttings (Hardwood cutting)	September–October.
Lime (কাগজি লেবু)	*Citres aurantifolia*	►By seed. ►Grafting and cutting also done.	All seasons.
Pomelo (বাতাবি লেবু)	*Citrus maxima*	►Pomelo can be propagated sexually by seed or asexually by air layering, grafting, budding & stem cuttings.	April—October.
Sapota (সফেদা)	*Manilkhara achras*	►Sapota is propagated by vegetative methods such as air layering or gootee layering, grafting and budding	April – October.
Stone apple (বেল)	*Aegle marmelos*	►Commonly grown from seed. ►Therefore, superior types must be multiplied vegetatively (air-layers or root cuttings)	February—April
Phalsa (ফলসা)	*Grewia subinaequalis*	►Seeds are the usual means of propagation ►Vegetative by air-layers.	April-June